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(54) Remote control transmit-receive system.

(57) A remote control transmit-receive system employs code patterns determined in the form of pulse intervals between the data pulses (D1-D3) constituting a command signal issued from a transmitter. Even if the command signal is affected by disturbance noise to indispose one or more data pulses in the command signal in transmission, it can be decoded from the sum total (B) of the pulse intervals of the data pulses (D1-D3) on a receiver side to enjoy high-quality transmission of the command signal.

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REMOTE CONTROL TRANSMIT-RECEIVE SYSTEM

This invention relates to a remote control transmit-receive system including a remote controller, capable of effecting high-quality transmission and reception of various command signals by using infrared rays, high-frequency waves, ultrasonic waves as a carrier wave irrespective of disturbance noises such as noises which are periodically generated from a fluorescent lamp or other possible atmospheric noises. The invention further relates to a method of digital data transmission.

Recently there have been widely used fluorescent lamps of an inverter type. The fluorescent lamp of this type inevitably generates optical noises substantially equal in wave length to the infrared carrier signals emitted from a common remote controller. The fact that the fluorescent light interferes with the carrier signals issued from the remote controller becomes an issue.

In order to solve the issue, as illustrated in Figure 1, a conventional device 2 which receives the command signals from the remote controller has been provided with a blocking member 4 so as to prevent the noise component (optical noise) issued from the fluorescent lamp 1 from entering directly into a sensor element 3 disposed on a receiver unit 2, or the fluorescent lamp 1 has been recessed into the ceiling so as not to throw the light directly on the sensor element.

In the drawing, reference numeral 5 denotes a filter disposed in front of the sensor element 3.

Otherwise, there has been so far employed a method of repeatedly emitting the command signal in the form of a train of pulses from a transmitter unit 6 as illustrated in Figure 2(A) so as to subject the command signal which reaches the receiver unit and can be decoded to data collation in the receiver unit as shown in Figure 2(B).

However, the blocking member 4 as noted above would not necessarily be adapted to various situations in which the transmitter unit 6 is placed and is not satisfactory.

When the fluorescent lamp 1 is fixed on the ceiling in its exposed state, the aforementioned blocking member does not effectively shield the light from the fluorescent lamp.

Also, the filter 5 disposed in front of the sensor element is not very useful because the wave length of the command signal is substantially equal to that of the light emitted from the fluorescent lamp.

When the intensity of the command signal issued from the remote controller is sufficiently larger than that of any disturbance noise,the noises can be eliminated, whereas the command signal would be affected by the noise when the remote controller is further away from the receiving device. When the disturbance noise becomes large in intensity relative to the command signal the noise is superposed upon the command signal and makes it impossible to decode the command signal.

Thus, the conventional remote controlling method has suffered a disadvantage that the efficiency of decoding the command signal issued from the remote controller cannot be increased even if the number of repetitions of the command signal is increased.

An object of the present invention is to provide a remote control transmit-receive system capable of effecting high-quality transmission and reception of command signals without being affected by disturbance noises such as the light of a fluorescent lamp.

To attain the object described above according to the present invention there is provided a remote transmit-receive system characterised in that it comprises a transmitter unit adapted to issue a command signal consisting of header pulses including a reference header pulse and data pulses subsequent to the header pulses, said data pulses each representing a digital value 1 or 0 so as to form a code pattern and occuring at inherent pulse intervals that are selected in accordance with their own digital values in such a manner that to each of a predetermined number of said code patterns there corresponds a given time length from a first pulse to a last pulse of a group of said data pulses defining the pattern, and a receiver unit adapted to receive and decode said command signal from said transmitter unit by finding said first pulse of said data pulses from said reference header pulse in said command signal and measuring said time length between said first and last pulses of said group of data pulses to reproduce said code pattern.

The time length from the first pulse to the last pulse of the data pulses is obtained by the sum total of the pulse intervals between the successive data pulses. Even if disturbance noise enters into the command signal to indispose one or more data pulses, the code pattern peculiar to the command signal transmitted from the transmitter unit can be decoded on the receiver side from the time length of the data pulses.

The first pulse of the data pulses can easily be perceived from the reference header pulse.

On the receiver side, the code pattern of the command signal issued from the transmitter unit can readily be recognized from the time length between the first and last pulses of the data pulses even if one or more data pulses are affected by the disturbance noise, because each of the data pulses is formed with its own digital value 1 or 0 and transmitted at the inherently determined pulse interval significant of the digital value.

Figure 1 is an explanatory diagram showing the state in which a conventional remote-controller is used, Figures 2(A) and 2(B) are explanatory diagrams showing a train of data pulses and the results of decision in the prior art remote-controller, and Figures 3(A), 3(B) and 3(C) are explanatory diagrams showing the waveforms of a command signal issued from a transmission side, a noise component, and the command signal received on a reception side in a system according to the present invention.

One preferred embodiment of the present invention will be described hereinafter with reference to the accompanying drawings.

Figures 3(A), 3(B) and 3(C) show a command signal transmitted from a transmission side, noise component, and the command signal received on a reception side.

The command signal transmitted from a transmitter unit consists of a series of pulses such as four header pulses H1, H2, H3 and H4 and data pulses D1, D2 and D3 following the header pulses. The data pulses are significant of a code pattern and repeatedly outputted several times. The pulse intervals between the adjacent pulses of the header pulses H1-H4 and the time length in which the header pulses occur are previously determined.

The data pulses D1 to D3 are determined on the basis of the header pulse H4 serving as a reference header pulse so that the first data pulse D1 is positioned as separated from the reference header pulse H4 with the time length (A). The data pulses D1 to D3 each representing a digital value 1 or 0 have their own inherent pulse intervals determined by the digital values and the sequence thereof so as to signify a code pattern of the command signal with the sum total of the pulse intervals (B) between the adjacent pulses of the data pulses.

Next, the signification of the codes of the data pulses will be noted below.

TABLE 1 shows the pulse intervals of the data pulses D1-D3, which are prescribed according to the sequence and digital value 1 or 0 provided for each data pulse.

TABLE 1 (Unit: ms)

Number	1	2	3	4	5	6	7..
Value 0	1.8	1.7	1.5	1.8	1.7	1.5	...
Value 1	2.3	2.9	3.6	2.3	2.9	3.6	...

As is clear from TABLE 1 above, when the first pulse is "0", the pulse interval from the first pulse to the second pulse is determined to 1.8ms, and when the second pulse is "1", the pulse interval from the second pulse to the third pulse is 2.9ms.

The following TABLE 2 shows the relations between the code pattern of the command signal to be issued from the transmitter unit and the sum total of the pulse intervals from the first to the last pulses of the data pulses.

TABLE 2

	Code Pattern	Sum of Intervals
0	000	5.0 ms
1	001	7.1
2	010	6.2
3	011	8.3
4	100	5.5
5	101	7.6
6	110	6.7
7	111	8.8

As shown in TABLE 2, the command signal having numerical value "2" which is represented by the binary digits "010", i.e. the first digit "0", the second digit "1" and the third digit "0", can be obtained by the sum total of the prescribed pulse intervals of data pulses as follows:

$$1.8 + 2.9 + 1.5 = 6.2 \text{ (ms)}$$

As will be apparent from TABLE 2 above, the sum total of the pulse intervals of the data pulses is peculiar to the command signal, and therefore, the code pattern of the command signal can be identified from the sum total of the pulse intervals mentioned above.

When the command signal shown in Figure 3(A) is affected by disturbance noise as shown in Figure 3(B), the data pulses D2 and D3 are indisposed with the result that the command signal assumes the waveform shown in Figure 3(C).

However, the code pattern of the command signal can be decoded by the sum total of the pulse intervals of the data pulses. That is to say, since the first pulse D1 of the data pulses is prescribed in position on the basis of the time length (A) from the reference header pulse H4 to the first pulse D1, the time length (B) for the data pulses D1 to D3 can be obtained by regarding the first pulse D1 of a second group of data pulses as the end point. From the time length (B) there can be identified the code pattern of the command signal in comparison with the prescribed code pattern as specified above.

Though the foregoing embodiment employs the data pulses consisting of three digits as one command, the number of digits is not restricted. Four or more digits may be of course used as a command.

The following TABLE 3 and TABLE 4 show another embodiment in which four digits are used as a command.

TABLE 3 (Unit: ms)

Number	1	2	3	4
Value 0	1.7	1.2	1.1	1.0
Value 1	2.1	2.8	3.4	4.1

TABLE 4

	Code Pattern	Sum of Intervals
0	0000	5.0 ms
1	0001	8.1
2	0010	7.3
3	0011	10.4
4	0100	6.6
5	0101	9.7
6	0110	8.9
7	0111	12.0
8	1000	5.4
9	1001	8.5
10	1010	7.7
11	1011	10.8
12	1100	7.0
13	1101	10.1
14	1110	9.3
15	1111	12.4

Though the foregoing embodiment relates to the remote control system using infrared carrier signals, this should not be understood as limitative. This invention may as a matter of course be applied to a remote control system using high-frequency waves, or ultrasonic waves as a carrier wave.

EFFECT OF THE INVENTION

As is apparent from the foregoing, in the remote control transmit-receive system, code patterns of a command signal issued from a transmitter unit are prescribed with the sum total of pulse intervals of data pulses constituting the command signal so as to determine a peculier time length for each code pattern. Therefore, the command signal can be decoded by collating the sum total of the pulse intervals of data pulses received by a receiver unit with predetermined reference code pattern represented by time lengths for data pulses, even if the command signal issued from the transmitter unit is affected by disturbance noise. The first pulse of the data pulses issued as the command signal can easily be recognized from a reference header pulse of header pulses issued prior to the data pulses. Besides, on the receiver side, the reference code patterns are predetermined in the form of time lengths in accordance with the digit informations of "1" and "0" and the sequence of the respective data pulses so as to facilitate the formation of the code patterns for identifying the command signal.

Claims

1. A remote control transmit-receive system characterised in that it comprises a transmitter unit adapted to issue a command signal consisting of header pulses (H1-H4) including a reference header pulse (H4) and data pulses (D1-D3) subsequent to the header pulses (H1-H4), said data pulses (D1-D3) each representing a digital value 1 or 0 so as to form a code pattern and occurring at inherent pulse intervals that are selected in accordance with their own digital values in such a manner that to each of a predetermined number of said code patterns there corresponds a given time length (B) from a first pulse to a last pulse of a group of said data pulses (D1-D3) defining the pattern, and a receiver unit adapted to receive and decode said command signal from said transmitter unit by finding said first pulse (D1) of said data pulses (D1-D3) from said reference header pulse (H4) in said command signal and measuring said time length (B) between said first and last pulses of said group of data pulses (D1-D3) to reproduce said code pattern.

2. A system according to Claim 1, characterised in that said transmitter unit is adapted to transmit said command signal by modulating a transmitted infrared carrier signal.

3. A system according to Claim 1 or 2, characterised in that said command signal contains a plurality of identical groups of data pulses transmitted consecutively, and said receiver unit is adapted to determine the time length (B) of a said group by locating the first pulse (D1) of the consecutive group.

4. A system as claimed in any one of Claims 1-3, characterised in that each said group of data pulses comprises consecutive pulses (D1,D2,D3) each of which has a different duration falling within an exclusive first range of values when it is to have the digital value 1, and has a different duration falling within an exclusive second range of values when it is to have the digital value 0.

5. A system as claimed in Claim 4, characterised in that there are three data pulses in each said group.

6. A system as claimed in any one of Claims 1-6, characterised in that there are predetermined pulse intervals between the adjacent header pulses (H1-H4), and that the duration of the group of header pulses is also predetermined.

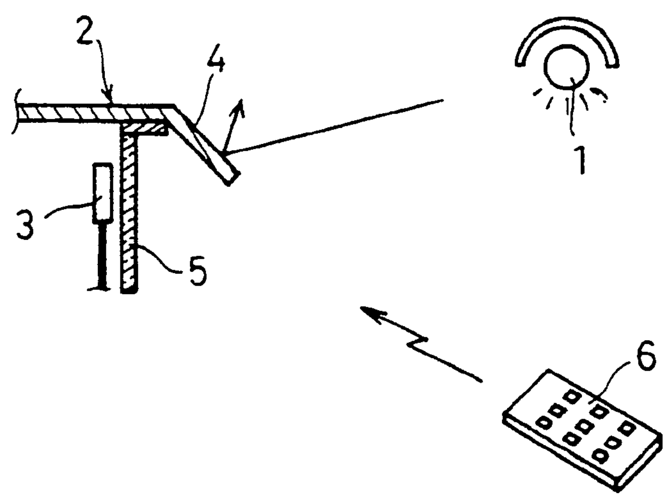
7. A method of transmitting a digital data signal characterised in that it consists of transmitting a group of consecutive data pulses, each pulse in the group having a different duration corresponding to its digital value, and the correspondingly possible durations of all pulses of the group being individually unique and being so selected that for each of a predetermined number of different code patterns of said group there corresponds a corresponding unique collective duration of the group of pulses.

8. A method as claimed in Claim 7, characterised in that a said group is transmitted consecutively with a distinct header signal identifying the start of the first pulse of the group.

9. A method as claimed in Claim 8, characterised in that a said group is followed by at least one further, identical group whereby the end of the last pulse of the group can be identified by the commencement of the first pulse of the consecutive group.

10. A method as claimed in Claim 8 or 9 wherein said header signal comprises a group of pulses having a predetermined duration and predetermined intervals between pulses of the group.

F I G. 1



F I G. 2

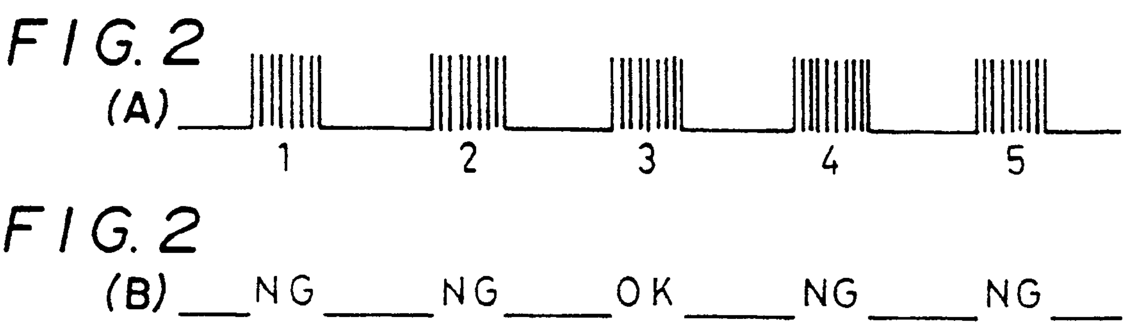


FIG. 3(A)
Transmitted Signal

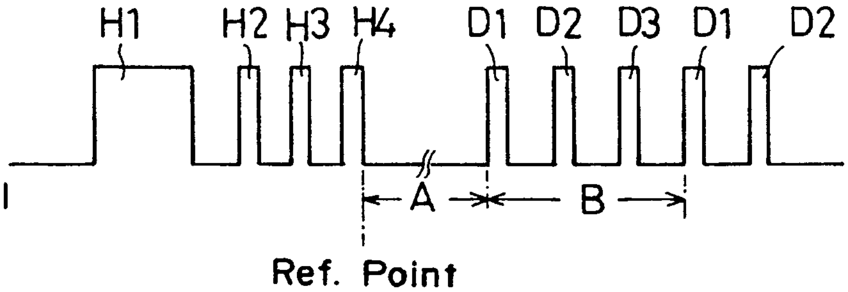


FIG. 3(B)
Noise Component

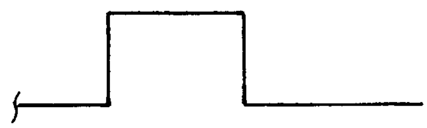


FIG. 3(C)
Received Signal